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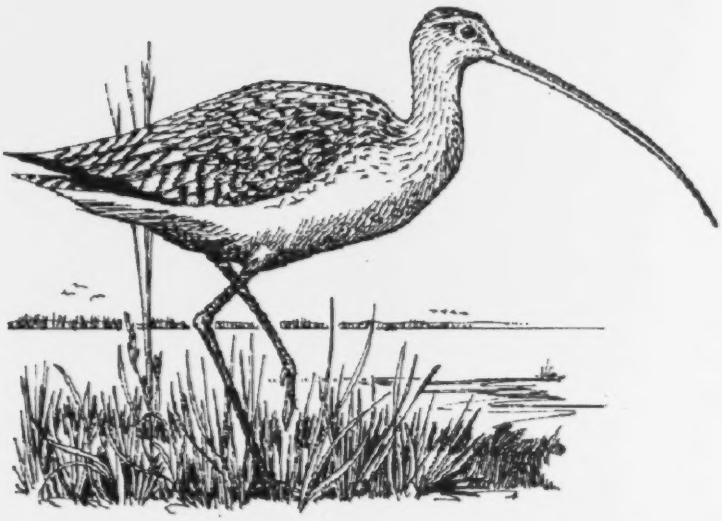
RESOURCE STATUS AND ASSESSMENT BRANCH

How Many Long-billed Curlews in Alberta?

A Review of Relevant Literature and Sampling Method for an Inventory of Long-billed Curlews *(Numenius americanus)* in Alberta



Alberta Species at Risk Interim Report

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

103-01857/

How Many Long-billed Curlews in Alberta?

A Review of Relevant Literature and a Sampling Method for an Inventory of Long-billed Curlews *(Numenius americanus)* in Alberta

Elizabeth J. Saunders

Alberta Species at Risk Interim Report
March 2001

Publication No. I/008
ISBN: 0-7785-1760-8 (Published Edition)
ISBN: 0-7785-1765-9 (On-line Edition)
ISSN: 1496-7219 (Published Edition)
ISSN: 1496-7146 (On-line Edition)

Cover Illustration: Brian Huffman

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This publication can be cited as:

Saunders, E.J. 2001. How Many Long-billed Curlews in Alberta: A Review of Relevant Literature and a Sampling Method for an Inventory of Long-billed Curlews *(Numenius americanus)* in Alberta. Alberta Environmental Protection, Fisheries and Wildlife Management Division. Interim Report No. 008. Edmonton, Alberta

Acknowledgements

Many people provided input and ideas for this report. I would like to thank Richard Quinlan for his guidance and direction and the following people for reviewing and providing valuable input on the draft report: Brenda Dale, Arlen Todd, Dave Prescott, Andy Hurly, Ron Bjorge and Cleve Wershler. Thank-you also to Lloyd Bennett, Janna Foster, Gary Erickson and Jennifer Lansing for providing information and to Al Smith for providing the result of his curlew surveys in Saskatchewan and Brenda Dale for providing the results of the Grassland Bird Monitoring Program. Shawn Pinder is thanked for conducting the GIS components of this project. Livio Fent and Lana Robinson are thanked for their assistance with the GIS components.

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1.0 EXECUTIVE SUMMARY

The long-billed curlew (*Numenius americanus*) is a large and charismatic upland shorebird that breeds in the grasslands of prairie Canada. The curlew is considered "may be at risk" in Alberta and of "special concern" in Canada. The curlew's status stems from historical hunting pressures and habitat loss. Little is known about the current population of long-billed curlews in Alberta. In order to implement effective management, a better understanding of the current population of curlews in Alberta is required. The purpose of this report is to develop an inventory method for estimating the 2001 population of long-billed curlews in Alberta.

In order to select the most appropriate methods for counting curlews in Alberta, literature pertaining to long-billed curlews was compiled and summarized. Although there have been very few attempts to estimate actual curlew populations, some researchers have experimented with methods of surveying curlews. The literature suggests that surveying curlews during the incubation phase appears to lead to the most accurate estimation of curlew numbers. As well as presenting information on curlew survey methods that others have used, this report summarizes information on curlew biology and ecology that has implications for developing an inventory method (for example, life cycle, territory, behaviour, habitat preferences and population dynamics).

The inventory method proposed in this report employs a stratified sampling approach. As curlews appear to be strongly associated with native grasslands, the sampling frame (Alberta's Grasslands Natural Region) has been stratified on the basis of the percentage of native prairie. Curlews will be sampled within each of three strata in an attempt to estimate the total population to within ±20%. Sample units will be 40km long and 1km wide. The majority of the sample units will be along roads, except in areas where there are no roads. Sampling units will be selected in an unbiased fashion. It is predicted that between 80 and 100 sample units will need to be surveyed to achieve the desired precision. Sample units will be surveyed during the incubation period (between April 25th and June 8th) from half an hour before sunrise to three to four hours after sunrise. To minimize observer variability, all observers will be required to attend a training workshop that will include information on curlews, the survey method and training in distance estimation. Observers will be required to collect basic habitat data and GPS locations within each sample unit.

The curlew inventory presents an excellent opportunity to collect information on other prairie wildlife species. Six prairie bird species have been targeted for data collection in conjunction with the curlew surveys; ferruginous hawk, burrowing owl, short-eared owl, upland sandpiper, Sprague's pipit and loggerhead shrike. Incidental observations will also be recorded for sixteen other species of prairie wildlife considered at risk or lacking in information.

2.0 INTRODUCTION

The long-billed curlew (*Numenius americanus*) is the largest member of the sandpiper family and although it is one of the grasslands' largest and most attention-grabbing shorebirds, surprisingly little is known about it. The curlews' distinctive down-curved bill and enchanting calls make it a notable and unforgettable part of the prairie landscape. Taverner (1934) describes the curlew as "the finest of shorebirds" and observes that it "embodies the spirit of the open range more than does any other bird".

Historically, curlew populations have declined across North American as a result of over-hunting and habitat loss (Johnsgard 1981). The species has been extirpated in several states, downward trends have been documented in areas where it remains relatively common, and dramatic range reductions have occurred in southeastern Saskatchewan and southwestern Manitoba. It is now considered extirpated in Manitoba (DeSmet 1992, Hill 1998).

In Canada the long-billed curlew is listed as a species of "special concern", meaning that it has characteristics that make it particularly sensitive to human activities or natural events (COSEWIC 2000). In Alberta the curlew is "blue-listed", meaning that it may be at risk. The 1998 Alberta status report on the long-billed curlew recommends formal population surveys in order to better assess the current population and implement effective management (Hill 1998).

The purpose of this report is to develop an inventory method for estimating the population of long-billed curlews in Alberta.

For many reasons, estimating the population of long-billed curlews in Alberta is a challenging task. Julia Allen sums it up in her 1980 wildlife monograph on the long-billed curlew:

"The fact that no total census of long-billed curlews exists reflects formidable logistics of surveying a range characterized by widely scattered pockets of suitable habitat within forbidding terrain remote from centers of human habitation. Moreover, the pairs disperse widely during the breeding season and their characteristic shyness makes them difficult to locate. None of those factors has encouraged an effort to make a complete count"
(Allen 1980, p. 23)

Despite these challenges, there have been some attempts at counting curlews in various regions. A few researchers have worked on developing and evaluating techniques for surveying curlews and there is no shortage of literature on general avian census techniques (for example, Bibby et al. 1992, Ralph and Scott 1981).

This report consists of two components:

1. The results of a review of the relevant literature about long-billed curlews and methods others have used for sampling curlew numbers. Additional information on curlews in Alberta was obtained from personal contacts with individuals who have knowledge of curlews and survey methods. Where appropriate, information was sought on survey methods used for similar upland shorebirds. The search for published literature on long-

billed curlews was initiated using the Biological and Agricultural Index (1983 - 2000) and Current Contents (1996 - 2000). References relating to any aspect of long-billed curlews were compiled (Appendix A) and the most relevant articles were obtained.

2. A proposed methodology for conducting an inventory of long-billed curlews in Alberta. This section includes information on sampling design, survey methods and protocol, required resources, data analysis and recommendations for assessing long-term population trends.

3.0 REVIEW OF EXISTING INFORMATION WITH IMPLICATIONS FOR SURVEY DESIGN

3.1 Existing Population Estimates for Curlews

Although there have been widespread observations of a downward trend in curlew numbers across North America since the 1930's (DeSmet, 1992), there have been very few attempts to gain a comprehensive population estimate of long-billed curlews. In the Columbia and northern Great Basins of the United States, Pampush (1981) estimated 8,000 – 13,000 curlews. In the COSEWIC report on the long-billed curlew, Ken DeSmet estimates that the overall population in Canada is between 4,900 and 7,800 birds (DeSmet 1992). He based this estimate on unpublished data from Alberta, Saskatchewan and British Columbia and extrapolation of habitat quantity and quality. The Saskatchewan data were collected as part of a study by Al Smith and Ed Driver of the Canadian Wildlife Service (A. Smith pers. comm.). In 2000, the British Columbia Conservation Foundation conducted a long-billed curlew survey in B.C. using volunteer surveyors (J. Lansing pers. comm.)

3.2 Counting Curlews – Methods Used by Others

Following are brief descriptions of census methods used in long-billed curlew studies:

Idaho (Redmond et al., 1981)
Redmond et al. (1981) evaluated breeding season census techniques for curlews in Idaho. They compared three different survey methods (spot mapping, variable distance strip transect method, and Finnish line transect method) with actual numbers calculated by intensive territory mapping. They found that most methods were very good at counting densities of male curlews during the arrival through incubation period. During the brood rearing period they found that daily tallies were very variable because the curlews tended to disperse from their territories. Female densities were highly underestimated by all methods. They concluded that the Finnish line transect method (Jarvinen 1976, Jarvinen and Vaisanen 1975) is the most reliable and efficient method for estimating the density of males attempting to breed in an area. Their transects were 8.23 km in length.

The Finnish Line Transect method (Jarvinen and Vaisanen, 1975) involves traversing a relatively straight line transect. Birds are recorded as to whether they occur within or outside of a specified "main belt". In the Redmond et al. study, the main belt was 25 meters. They make the assumption that bird detections decrease linearly from the observer.

Washington (Allen, 1980)
In her intensive study of long-billed curlews in south-eastern Washington, Allen (1980) surveyed curlews by making weekly road counts that consisted of stopping every quarter mile (0.4km), walking a short way off the road, imitating a curlew call and recording the number and sex of the curlews that responded. She conducted this survey from mid-March, when the birds first arrived to mid-July, when they left. Birds were also counted at loafing and staging areas on a daily basis towards the end of the season.

Oregon (Pampush and Anthony, 1993)

In Oregon, Pampush and Anthony (1993) used a rather labour-intensive approach for counting curlew nests. They searched for nests by having people walk approximately five meters apart in a straight line across the study plot. They did this for a total of 24 40ha sample plots. To do this they used 1,300 volunteer high school students! They also used a modified strip transect technique that involved walking long (length not specified) transects on foot. They recorded all curlews within 50m of the transect centre line (except for incubating adults). Curlews flying over were not included unless they were males performing flight displays. They conducted these surveys during the early morning hours when curlews were most active. When adults with broods were surveyed, the survey strip was widened to 150m on either side since curlews with young exhibited strong defensive response to intruders (on foot or vehicle). They found that 150m is approximately the maximum distance at which curlew with broods responded to humans.

Wyoming, (Cochrane and Oakleaf, 1982)

In a Wyoming study, Cochrane and Oakleaf (1982) tested the suitability of standard breeding bird survey (BBS) methods for obtaining useful abundance information on long-billed curlews. They conducted their study during the incubation period. In addition to counting observed birds for three minutes at each stop, they walked 100 m behind their truck after the three minute observation period. They expected that this would reveal more curlews that had gone unnoticed. However they found that this did not reveal any additional curlews, as the truck generally flushed any birds in that area. They also attempted to count curlews while driving at 20-25 mph along a set route. They found that this technique revealed similar curlew densities as when using the standard BBS methods. Cochrane and Oakleaf concluded that BBS techniques are adequate to detect curlews if conducted in May and June. However, as only very low numbers of curlews are recorded on BBS routes, they suggest that there needs to be a great increase in the number of randomly selected roadside surveys in order to adequately monitor curlew population trends.

Saskatchewan (Foster)

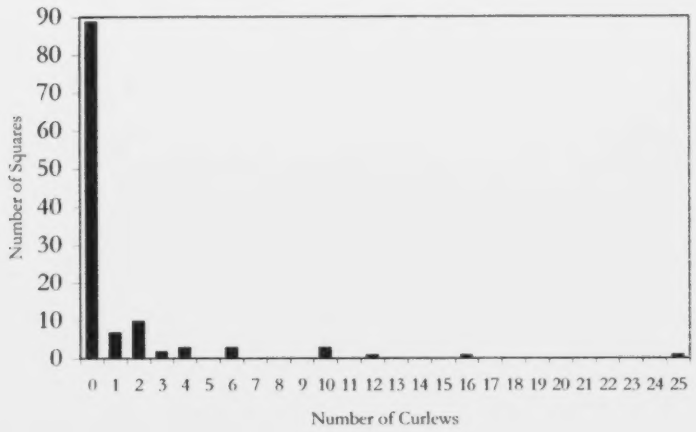
In 1999 and 2000, Janna Foster, a graduate student from the University of Regina conducted her M.Sc. research on long-billed curlews in Saskatchewan (J. Foster, pers. comm.). Her study area was approximately 8000 square km, between Maple Creek and Leader. She conducted surveys in three time periods: prelay (late April), incubation (May), and hatch (early-mid June). She surveyed transects along roads by stopping every mile and listening for curlews for five minutes. Her results are being compiled this winter.

Saskatchewan (Driver and Smith)

From 1988 to 1991, Ed Driver and Al Smith of the Canadian Wildlife Service conducted a survey of curlews in Saskatchewan. They randomly selected townships in the prairie portion of Saskatchewan and surveyed curlews in a 16 section square ($41km^2$) within each township, using existing roads. They sampled approximately 5% of the prairie portion of Saskatchewan (120 plots in 1988). They felt that there was considerable bias in their survey because some townships had more roads than others and where there were few roads, coverage was weak (Al Smith, pers. comm.). The survey was conducted from late April to early June. There was a very high variance in their sample; many survey squares contained no curlews and some contained many curlews. This is evident from Figure 1, which shows the results of their 1988 surveys. Eighty-nine of their 120 survey squares showed no curlews. They estimated a minimum

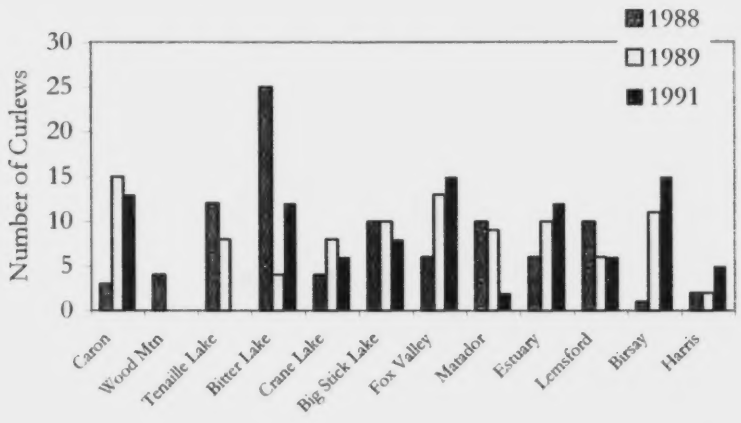
population size of 2000 curlews in Saskatchewan (A. Smith, pers. comm.). Mean number of curlews per township was 1.22, with a standard deviation of 3.39 and a variance of 11.5.

Figure 1: Frequency Distribution of Curlews
(from Al Smith and Ed Driver's 1988 Curlew Survey in Saskatchewan)



In 1989 and 1991 they re-surveyed 12 of the plots that had relatively high numbers of curlews in 1988. As Figure 2 shows, on some of the plots there was some between-year variance.

Figure 2: Number of Curlews per Survey Square over Three Years
(from Al Smith and Ed Driver's 1988 Curlew Survey in Saskatchewan)



British Columbia (Lansing)
In 1999, the British Columbia Conservation Foundation initiated a long-billed curlew survey. They attempted to combine techniques from the Breeding Bird Survey the Christmas Bird Count and the Nocturnal Owl Survey. Unfortunately, further details and results from this study were not yet available when this report was completed.

3.3 Surveys of Similar Upland Shorebird Species

Although there has been limited work done on other upland shorebirds species in North America, there is a considerable body of work on upland shorebird species in Europe, such as the European curlew (*Numenius arquata*) and Lapwing (*Vanellus vanellus)*. Following is a brief summary of studies involving similar upland shorebirds where survey methods were employed for estimating the number of individuals. Only the methodological information is relayed here, results are not reported unless they are relevant to survey design. One point to note is that the European studies are often operating on a very different scale compared to North American studies. For example the British lapwing study area encompassed 1,713 10km by 10km squares. The grasslands natural region in Alberta contains over 12,000 such squares – a much more challenging sampling frame!

Upland Sandpiper (Bartramia longicauda) in Wisconsin (White, 1983)
This study used data from Breeding Bird Surveys (BBS) plus four additional survey routes using BBS methods. Four additional routes were surveyed eight times between April 21 and June 24. The focus of this study was habitat relationships and population trends. They did not try to infer overall population numbers from these data.

Upland Breeding Birds in the Penines, England (Stillman & Brown, 1995)
One of the primary purposes of this study was to test the effectiveness and efficiency of three different sampling methods in surveying the populations of 10 species of upland breeding birds. They used the following three sampling methods, briefly described here: **Random sampling** , which requires no previous knowledge of distribution. **Regression sampling**, which is an extension of random sampling, but environmental variables are recorded throughout the study area. The association between bird distribution and these variables in the sample squares are then used to estimate bird populations throughout the study area with more precision than with simple random sampling. **Stratified sampling**, which requires recording environmental features throughout study area and may require some previous knowledge of variation in bird numbers across the study area.

For this study, the sampling units were 1km squares. Observers walked through the square and spent 80-100 minutes per square. They recorded the number of pairs of birds showing evidence of breeding.

The European Curlew (*Numenius arquata*) was included in this study. They found that for curlews, in order to estimate the population to within ± 10% using a **random sampling** technique, they needed to sample 42.6% of the area. For ±20%, they needed to sample 15.6% of the study area. In this case they found that curlews were relatively evenly distributed over the

landscape in the Penines. However they found that even in populations of species with a high coefficient of variation, no more than 30% of the squares needed to be surveyed in order to estimate populations to within a 50% error.

Obviously the efficiency of **regression sampling** methods increases as the size of bird-habitat correlations increases, but *large reductions in sample size can only be achieved if bird species are highly correlated with habitat features.* For Penine species, they found that the correlations would have to be greater than 0.5 for regression sampling to reduce survey effort by more than 20% of that required for random sampling.

In stratified sampling the allocation of survey effort to each stratum is related to both stratum size and the variability of bird populations in the stratum. More effort is put into larger stratums. As well, less effort is put into surveying strata where there is less variation in bird numbers. Stillman and Brown concluded that "*This method of allocating survey effort can lead to the greatest reductions in overall survey effort, but requires a previous survey to have been carried out in order to estimate bird variation within strata*". They recommend that any sampling method should require a pilot study to determine the degree of dispersion in species distribution.

Lapwing (Vanellus vanellus) study in UK (Shrubb and Lack, 1991)
A stratified sample was used to determine the size and geographic distribution of the nesting population of Lapwings in England and Wales. They divided the study area into 1,713 10km^2 squares. In each square they randomly selected a 2km by 2km tetrad (out of 25 such tetrads in the 10km^2 square). They did a complete count of nesting Lapwings in the tetrad. As Lapwings often move around when rearing chicks, the counts were done in April during the peak of the incubation stage of the breeding cycle. Observers were asked to examine every field in the tetrad and to count territorial males, pairs or if possible, incubating birds. Using this method they estimated 123,134 pairs of Lapwings in England and Wales, to within ±11% (at 95% confidence limits).

Curlews (Numenius arquata) in the U.K (Grant et al. 2000)
In this study the researchers tested the reliability of the "field by field" method for estimating the abundance of breeding curlews. They compared the results of an intensive territory mapping study with field by field surveys conducted in the same study areas. Each site was visited three times by the surveyors within three hours of dawn or dusk. The surveyor walked to within 100 meters of each part of the field within the site, but did not follow a set transect route. At the end of each survey, an estimate was derived for the number of breeding Curlews based on paired individuals, displaying birds, nests or broods. They found that "field by field" surveys can produce accurate estimates of breeding curlews. Grant et al. also provide a calibration equation for curlews, based on the differences they found between actual densities and survey results. Surveys conducted before or during the onset of egg laying produced the weakest abundance estimates. They caution counting curlews during the hatching to fledging stage because the distances that broods move could influence the validity of the results.

Stone Curlew (Burhinus oedicnemus) distribution in Wiltshire, U.K. (Green and Taylor, 1995)
This study was conducted by systematically searching the entire study area (1700ha) for stone curlews (breeding pairs and nests). The stone curlew is a very rare bird in Britain, and the study

area contained only 15 – 21 pairs. Thus, the methods used are not very relevant to the Alberta curlew study.

3.4 Summary of Common Findings from Literature

Although the above studies differ widely in terms of their objectives, there are several commonalities and findings in the methods for sampling curlews and their close relatives. These are briefly summarized here:

1. Surveys to gain accurate population estimates should be undertaken during the incubation period (for example, Redmond et al. 1981, Cochrane and Oakleaf 1982, Grant et al. 2000).

2. Driving and stopping surveys have been found to be effective in estimating numbers of curlews (for example, Allen 1980, Cochrane and Oakleaf 1982, J. Foster pers. comm.). An observation period of three to five minutes was most often employed at stops (Cochrane and Oakleaf 1982, J. Foster pers. comm.).

3. Reduction of variance in sampling curlews is critical and can sometimes be achieved through stratification on the basis of habitat (Stillman and Brown 1995, A. Smith pers. comm.).

4. Although playing and/or imitating curlew calls to attract curlews was used in one study (Allen 1980), others have found it to be ineffective (J. Foster pers. comm.).

5. Intensive "field by field" walking surveys have been found to be highly effective for estimating curlew populations in the U.K. (Grant et al. 2000). However considering the sampling area in Alberta, such an intensive method would be impractical.

3.5 Biology and Ecology of the Long-billed Curlew with Survey Implications

3.5.1 Life Cycle

The life cycle of the long-billed curlew has many implications for the timing of surveys. Table 1 shows a summary of the approximate timing of curlew activity in Alberta.

Table 1: Timing of Curlew Activity in Alberta

Activity	Activity dates	Information based on
First arrivals in Alberta	April 13th	Sadler and Myers 1976, Pinel et al. 1991, pers. obs.
Peak of curlew arrival in Alberta	April 13th – 24th (averages about April 17th)	Sadler and Myers 1976, Renaud 1980, Pinel et al. 1991, pers. obs.
Begin incubation	April 30th – May 25th	Renaud 1980
Hatching (incubation is ~28 days)	May 28thrd – June 19th	Inferred based on other dates, Renaud 1980
Fledging* (after ~43 days)	July 1st – July 27th	Inferred based on other dates, C. Wershler pers. comm.
Leave Alberta	Aug 15th – Sept. 2nd	Sadler and Myers 1976, Pinel et al. 1991, pers. obs.

* When young are able to fly

Table 1 is an approximation of the widest range of dates for which curlews are incubating and brooding. The estimates are based on arrival dates and a few nest records. The start and end dates are probably the extremes and the majority of curlews likely fall somewhere in the middle of these extremes. Observation records that help to support dates in Table 1 include:

- Sadler and Myers (1976) report a nest record from the Claresholm area with four eggs on May 15th.
- Lloyd Bennett (pers. comm.) reports a nest with eggs from May 13th, 1991, near Taber and two week old young on June 14, 1991.
- On July 17th 1926, in the Battle Creek area a male with three young was collected (Williams, 1946).
- Rand and Clemens saw half-grown young on June 29th in the Irvine area (Rand 1959).
- From Suffield surveys there are reports of young curlews from June 18 to July 4 (B. Dale pers. comm.).
- Renaud (1980) found that incubation ranged between May 3rd and June 19th in Saskatchewan. His study concluded that the height of incubation was from mid-May to mid-June. Renaud found pipped eggs as early as June 10th and fledged juveniles as early as July 5th. He noted that family groups begin to gather together by mid-July. In these cases the eggs must have been laid by the first week of May.
- C. Wershler (pers. comm.) reports fledged young on July 1st, 1986 in the Remount Community Pasture, Alberta.

The critical information from Table 1 and the observations above is the incubation period, which in Alberta may stretch from April 30th to June 15th. This estimate was confirmed with Taber-area naturalist, Lloyd Bennett, who kept detailed bird records in the Taber area from 1980 to 1991. This estimate of incubation time is exactly in keeping with his records (L. Bennett, pers. comm.). From these data we can infer that the peak incubation period, when most curlews in Alberta are incubating is likely from about May 10th to June 8th.

Redmond et al. (1981) argue that the most favourable time in which to survey curlews is from the period of peak arrival through to the end of the incubation period. During this time female curlews are less detectable than males, so surveys conducted at this time would be primarily counting males. Once the young have hatched, Redmond found that transect methods overestimated male densities because of male mobbing behaviour. Once broods are between two and three weeks old, the females abandon them but the males continue to guard the young until they fledge at 41-45 days.

It is important to note that after hatching, broods can move considerable distances from the nest. Sadler and Maher (1976) report " on June 18th, a brood that had been banded in the nest on June 12th was found with its parents more than 6.5km from the nest site". This particular brood was averaging a kilometer of travel a day!

Alberta Survey Recommendations

- *The Alberta curlew survey would be best conducted while the birds are on their nesting territories, which in Alberta is between April 25th (when most birds have returned) and June 8th (towards the end of the incubation period).*
- *As females incubate during the day, the survey would primarily be counting breeding males.*
- *It is recommended that surveyors record the sex of curlews observed, where possible.*

3.5.2 Territory

Long-billed curlews have been shown to have well defined territories (Johnsgard 1981). It would appear that territory size varies widely depending on habitat. At Allen's study site in Washington, she found they varied from 6-8 ha in varied habitats to 20 ha in open, flat, more uniform habitats. She also found that the same territories were used over her two-year study and she believes them to be historical. An increase in the number of birds in her study area did not result in reduction of territory size but rather in an increased utilization of marginal areas and some birds that seemed not to nest at all. At first arrival on their breeding grounds, curlews would range over large overlapping areas, covering parts of several territories. The boundaries were not defined until more birds had arrived in the area (Allen, 1980). This suggests that surveys of long-billed curlews should be conducted only after all birds have arrived on the breeding grounds.

Pambush and Anthony (1993) commented that when not incubating, nesting adult curlews often foraged away from their territory. This has obvious implications and complications for a population survey. Allen (1980) comments that the curlews leave their territories to feed **during the heat of the day**. Incidentally, Cochrane and Oakleaf (1982) found that morning counts yielded more curlews and more favourable weather conditions, compared to afternoon counts.

Alberta Survey Recommendations

- *Conduct surveys once all curlews have returned to the breeding grounds in Alberta.*
- *As curlews may leave their territories to feed elsewhere during the heat of the day, surveys should be done early in the morning (i.e. half an hour before sunrise to approximately three hours after sunrise).*

3.5.3 Behaviour

An understanding of curlew behaviour and displays is important for determining the survey method and will be especially important for the field observers to be aware of when counting animals. Allen (1980) gives a very detailed description of curlew displays, including drawings. Only a summary is given here, based on Allen (1980):

Territorial Defense and Advertisement

Territorial defense is performed by the male. One of the associated displays is the "bounding-SKK flight": The male ascends almost perpendicularly, then glides with his wings curved downward, sometimes almost touching the ground before rising again. He gives a series of soft kerr kerr (SKK) notes that are repeated in series. The sound is described as "like the noise made by blowing through a pipe". This flight apparently serves to advertise a male's unpaired status. Although this is the display behaviour most often described in literature about long-billed curlews, it is only observed for up to three days and takes place almost exclusively on the first day a male pairs up with a female.

Ground calling is also performed and this consists of various drawn-out "whee" notes. It is sometimes used by a member of a pair, but it usually serves to attract females to unpaired males. Some curlews arrive on the breeding grounds already paired. Birds that arrive paired begin their courtship activities with scraping and precopulatory displays. Paired birds perform a scraping ceremony on a variety of potential nest sites (Allen, 1980).

Daily Routine

Allen (1980) eloquently describes the daily routine of curlews:

"Each day begins approximately one half hour before dawn with repeated volleys of Whistling as individual birds call out one after another from their roosting sites. "Curlee Curlee" and "Wheet Wheet" calls may also be heard, but Whistling is the most common. Periods of quiet are interspersed with such rounds of Whistles, but the vocalizations continue until the birds begin their other daily activities.

During the first two weeks following arrival, the birds are very active on their territories. There is rarely a peaceful moment during the day as calls ring incessantly across the fields, birds fly back and forth across their territories, solicitation and courtship begin with a frenzy, and agonistic encounters occur frequently. Unpaired males are particularly vocal and the majority of their time is spent maintaining a visible profile. Paired and unpaired birds alike frequently move in and out of their nest fields all day long.

Courtship displays are most frequent during the early morning hours from dawn to about midmorning, but commonly continue through the morning and into early afternoon during the initial period. Courtship activities by one pair appear to stimulate courtship activities in neighbouring pairs (social facilitation) as frequently 3 or 4 pairs will be courting within sight of eachother. All reproductive activity is, however stifled during inclement weather as the birds tend to stay in the shrub areas where there is more protection.

After about the first 2 weeks, but still prior to incubation, daily activities become more routine. Territorial pairs usually are in their nest fields only during the early morning, later afternoon, evening and night. During the day, they feed quietly in the shrub areas within their territories, occasionally coming out into the open for maintenance activities or to pursue an intruder, or they are gone from their territories entirely, having moved to other areas to feed. Courtship displays in pairs are performed almost entirely during the first few hours of light. Paired birds have developed patterns for feeding, courtship and mating that they follow routinely. The unpaired males continue to maintain a high profile as before, through perhaps with a little less vigilance, and tend to be much less routine in their activities.

All birds usually leave their territories once a day for several hours (less for unpaired males) during the heat of the day to feed in irrigated fields or in other areas of the Hanford Site, and/or to loaf on islands in the Columbia River. The daily departure of a pair from their territory is often preceded by "Wheet", "Curlee" and "Curlee Wheet" calls for up to 10 minutes while the birds walk and feed. Commonly when a territory is un-attended, neighbouring birds will trespass flagrantly."

Incubation

Once egg laying is complete, the female curlew incubates during the day and the male incubates at night. Once the incubation phase is underway in an area, the birds are much quieter and only unpaired males and transient individuals participate in ex-changing whistles at dawn. The birds remain relatively quiet unless disturbed (Allen, 1980). During the day, when the female is incubating, the male may or may not be present on the territory. Some males leave for only one to two hours, spending most of the day feeding within the territory, while others are gone until nest relief time and leave the female to fend for herself (Allen, 1980).

Reaction to Human Disturbance

During incubation, if a human enters a nest field when a non-incubating bird is nearby, the bird becomes alert and usually gives a chirping and wheet-wheet-wheet call. If the intruder does not leave, the bird performs "demonstration" with displacement feeding. Demonstration is a specific wader behaviour that is essentially an aerial and vocal reaction similar to the mobbing behaviour of other bird groups. Demonstrating curlews circle an intruder, and make short flights from

place to place, giving repeated "Wheet Wheet", "Curlee Curlee" and chirping calls. Sometimes the enticement-run is performed (see Allen 1980 for further details). If an intruder comes within 10-15m of the nest, the non-incubating bird stops displaying and calls a soft, rapid "whee whee wheet" or "curlee curlee". The bird on the nest stays put, lying as close to the ground as possible. It does not raise its head until the non-incubating partner stops calling or whistles an "all clear". Incubating females will only flush if the intruder comes within 2m of the nest. Males sometimes leave the nest before an intruder is close enough to locate it. When flushed from a nest, curlews often perform a broken wing display for about 10 –20m. Neighbouring birds tend to join in the commotion. Once the intruder has departed, the incubating bird may take up to an hour to settle back on the nest. That period is crucial for the eggs during hot weather (if left exposed for too long in hot weather, the embryos can be killed). The male often returns to the nest first even when it is not his turn to incubate (Allen 1980).

After their eggs have hatched, the adults perform a protective response to intruders that is not seen during incubation: Arc displays are directed at human intruders as well as others. Again, other curlews in the area are attracted to the scene.

Once they have young chicks, the area defended is a minimum distance from the chicks themselves, rather than the entire territory as was the case prior to hatching. Therefore, as the chicks move, so does the area defended.

Alberta Survey Recommendations

- *Record separately birds that are initially in the study area versus those that are arriving in response to the alarm calls of others.*
- *Avoid conducting surveys in inclement weather as much as possible.*
- *Ensure that field observers are given a basic knowledge of curlew behaviour and displays.*
- *Where possible, have field observers record behavioural observations (as long as it does not slow down the surveys too much).*
- *Use a survey method that is non-intrusive and will not result in birds being flushed from their nests (to avoid overexposure of eggs).*

3.5.4 Habitat Preferences

If an attempt is going to be made to stratify the sampling method for estimating curlew numbers in Alberta, it will most likely be done on the basis of habitat preferences. Therefore it is important to have some knowledge of the habitat preferences of long-billed curlews. A difficulty here is that their preferences appear to vary across their range. Because of this, the focus here is on what is known about their habitat use in Alberta and Saskatchewan.

The long-billed curlew is primarily associated with grassland habitats during the breeding season (DeSmet 1992). In 1929, Bent noted that north of the Cypress Hills, the curlew showed a "decided preference for damp, grassy hollows in the prairie, or long slopes near lakes or watercourses". At Matador, Saskatchewan, they were found to nest in dry, open prairie and families moved to denser cover after hatching (Sadler and Maher, 1976). Renaud (1980) reported long-billed curlews from fallow and stubble fields, and in forage crops or grain crops, but usually where these abut prairies or shrublands. He comments that the long-billed curlew is rare or absent as a breeder in large areas under complete cultivation. It is not found on the upper escarpment of the Cypress Hills, likely because there is too much grass cover (Renaud 1980).

In Oregon, Pampbush & Anthony (1993) found that short or freshly swathed alfalfa was used extensively as foraging areas by curlews even though no nesting was observed in this habitat. Redmond and Jenni (1986) observed curlews flying to undefended foraging sites on agricultural land within 10km of their territories in western Idaho. He found that they were especially likely to do this when dense residual vegetation covered most of their territories.

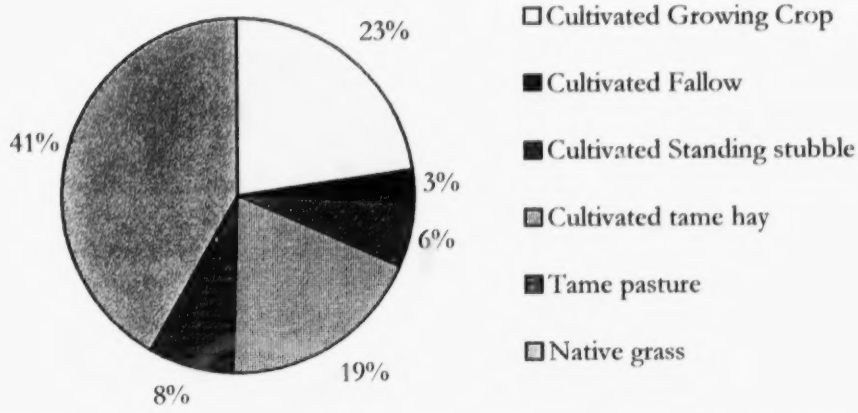
In general, vegetation structure appears to be very important to long-billed curlews. They commonly prefer short grass (less than 20 - 30 cm) that allows for good visibility of approaching danger. Irregular spacing of grass clumps are also desirable, as these complement their cryptic colouration and help to conceal the curlews from predators (Fitzner 1978, Allen 1980).

In Alberta, curlews use tame pastures but at somewhat lower densities than in native habitats (Prescott and Bilyk, 1996). Agricultural land used by breeding curlews usually has a similar vertical profile to that of native prairie (DeSmet, 1992). Owens and Myres (1973) found that curlews were 4.5 times more abundant in native grasslands compared to cultivated land in the Hand Hills area of Alberta.

Although seldom referred to in the literature, there appears to be a strong association between curlew densities and loose, sandy soils (DeSmet 1992, A. Smith pers. comm., B. Dale pers. comm.). It is not clear if this relationship is due to the resulting vegetation characteristics or improved foraging opportunities (for instance, the looser soil may make it easier to probe for insects).

In the survey conducted by Al Smith and Ed Driver in 1988, they recorded the habitat types that curlews were observed in and found that 42 percent of the curlews were observed in native grassland. A fairly high percentage of curlew observations were made in cultivated growing crops (23%). Perhaps like sandy soils, cultivated soil improves foraging opportunities. Figure 3 shows their results. Very similar habitat preferences were found in their follow-up surveys in 1989 and 1991.

Figure 3: Curlew observations by Habitat Type
(from Al Smith and Ed Driver's 1988 Curlew Survey in Saskatchewan)

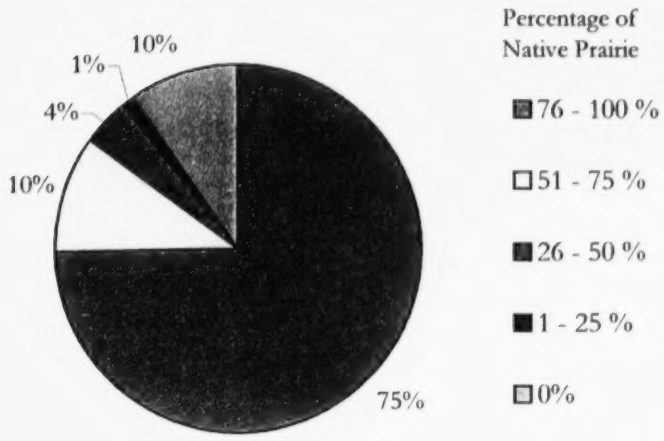


Although Janna Foster's study in western Saskatchewan focused on habitat preferences of long-billed curlews, her data analysis has not been completed, so could not be included here.

In the Canadian Wildlife Service's Grassland Bird Monitoring Program, they found that on average, over four years, only 6.7% of curlew observations were made in cropland, the remainder being observed in grasslands (B. Dale, pers. comm.).

Alberta's Biological Species Observation Database (BSOD) currently contains 166 long-billed curlew observations. To gain an impression of the relationship between long-billed curlews and native grassland, BSOD's curlew data was overlaid with Alberta's Native Prairie Database (ANPD). The Native Prairie Database classifies the grasslands natural region into five classes depending on the amount of remaining native vegetation. This is done to a scale of a quarter section. The results of comparing BSOD data with the ANPD are shown in Figure 4.

Figure 4: Long-billed Curlew Observations by Native Prairie Class
(from the Biological Species Observeration Database)



As Figure 4 shows, 75% of the curlew observations in the BSOD database fall in areas of 76 - 100% native prairie cover. Looking more closely at the 16 observations made in areas of 0% native prairie, it was found that only three of these were breeding records (two probable breeding records and one nest record). Although it shows up in a quarter section with no native prairie according to the ANPD, the one nest record was immediately adjacent to a quarter section with 76 – 100% native prairie and was recorded in BSOD by Cleve Wershler as "nest with 3 eggs in native grassland". The other two probable breeding records were within one kilometer of native prairie. The remaining 13 observations in the 0% native prairie class were from late June and July, after the incubation period. It is important to consider the source of this data. Most of the BSOD curlew observations were incidental observations from studies being conducted in native prairie, so the data is likely already biased towards observations in or near native prairie areas. One of the studies included was a pipeline study. Presumably all curlews along the pipeline route were recorded, regardless of habitat type. Looking solely at the curlew observations from this study, out of 33 curlew records, 31 were in areas of 76 – 100 % native prairie.

The effect of grazing on curlews varies across their range. In Alberta, maximum breeding densities have been in moderately grazed mixed grasslands (DeSmet 1992, C. Wershler pers. comm.). In the moister parts of the curlews' range in Alberta, such as in fescue grasslands, curlews require more heavily grazed conditions, whereas in the drier parts of their range, moderately grazed grasslands are used (C. Wershler, pers. comm.). Gary Erickson (pers. comm.) remarks that in southern Alberta, curlews seem to be more common in areas of good grass cover. Curlews may prefer different grazing levels for different functions. They often nest in moderately to heavily grazed grasslands, but are also observed feeding in ungrazed grasslands (C. Wershler, pers. comm.).

Alberta Survey Recommendations

- *Have field observers record basic habitat information (on a checklist) while conducting surveys in order to increase knowledge of habitat preferences.*

- *As curlews appear to have a preference for native grasslands, to increase precision of the survey, the sample units should be stratified based on percent native prairie. Within the strata, sample units should be selected randomly.*

3.5.5 Population Dynamics

Population dynamics come into play when interpreting the results of counts and determining counting protocols. Male long-billed curlews do not usually attempt to breed until they are three years old. Females start breeding at two to three years old (Redmond and Jenni 1986). It is not clear if non-breeding adults migrate to the breeding grounds or remain on the wintering grounds. From the literature there appears to be evidence of both. Redmond and Jenni (1986) did not observe any yearlings on their breeding grounds in their study area of western Idaho. They also report records of long-billed curlews remaining on their wintering range throughout the year, suggesting that yearlings and some two-year olds may not attempt a northward migration. However, Allen (1980) observed small flocks of curlews in her study area that were likely sub-adults. In Allen's study area, she found 100 birds, of which approximately 60 were paired, 20 were unpaired but territorial and 20 were unattached individuals.

At Suffield, two flocks of 58 and 70 curlews were observed feeding together in June, but it was not determined if they were yearlings or adults (B. Dale pers. comm.). The Biological Species Observation Database contains the following record from Wayne Smith: "On July 18th, he observed a group of 50 adults and 50 young south of Bindloss. On the same day he reported a group of 100 adults and 100 young north-east of Bindloss." On August 2nd, 1986 250 birds were observed at Prince's Spring on the Remount Community Pasture (C. Wershler pers. comm.). At the same location on July 26th, 1987, over 400 birds were observed (C. Wershler pers. comm.).

Redmond and Jenni (1986) estimate the average longevity of long-billed curlews to be 8 – 10 years. They found that males are more likely to return and breed in their natal area than are females. They suggest that females disperse long distances before breeding. This obviously has important ecological and management implications for long-billed curlews. It means that adequate productivity, sub-adult survival and adult survival in one population may not be sufficient to ensure its growth or stability. The productivity of other populations that supply female recruits as well as sub-adult survival of these recruits also must be considered.

Curlews that lose their clutches will defend their territory for a week to 10 days afterwards. After that, they depart and presumably migrate south (Allen 1980).

Alberta Survey Recommendations

- *Have field observers record adult and juvenile curlews separately.*
- *Again, conduct surveys during the incubation period while birds that have lost their nests are still on their breeding grounds.*
- *Remember in interpretation of the results, that part of the population may not be in Alberta (for instance, the one and two year old birds).*

3.6 Existing Curlew Breeding Density Estimates

An important piece in the puzzle of determining survey methods and particularly in determining sample size is to have an estimate of curlew densities in Alberta. This information will help to determine an appropriate size for sample plots and the number of sample plots that are required. For statistical precision there should, of course, be more than one animal per sample unit (Thompson et al. 1998). There have been several studies in North America that have attempted to estimate curlew density on their breeding grounds. Table 2 summarizes the results for North America and for Alberta:

Table 2: Density Estimates for Long-billed Curlews

Region	Habitat comments	Pairs per km^2	Study	Comments
Washington (SE)	In favourable habitat	1.5	Fitzner 1978	In favourable habitats, more usually under one pair per km^2
Nevada	In grazed habitats	4.5	Medin and Clary 1990	In grazed habitats
Idaho		2.5	Jenni et al. 1982	
Washington		0.6 - 1.5	Allen 1980	
Idaho (W)		5 - 7	Redmond and Jenni 1986	
Oregon	Cheatgrass habitat	9.0	Pampush and Anthony. 1993.	Found to be most favourable habitat
Oregon	Bitterbrush habitat	1.25	Pampush and Anthony. 1993.	Least favourable habitat
British Columbia		4.1	Ohanjanian 1985	
Saskatchewan		0.14 - 0.16	Sadler and Maher 1976	
Alberta	Native prairie	1.7 – 2.7	Prescott & Bilyk 1996, Prescott 1997	
Alberta	Agricultural land	0.4 – 0.9	Prescott & Bilyk 1996, Prescott 1997	

As Table 2 shows, there is a great deal of variety in curlew densities between regions. From this, we can summarize that densities found in Alberta likely range from 0.14 – 3 pairs per square kilometer. However, it should be remembered that this is based on very scant information. In the Saskatchewan study in 1988, the township with the highest concentration of curlews had a density of 0.6 curlews per square km (Al Smith, unpublished data).

Alberta Survey Recommendations

- *To count at least one curlew per survey unit, survey units need to be at the very least 7 square kilometers in size. It is recommended that they be considerably bigger than this to reduce the variance in the sample.*

3.7 Curlew Distribution

A further piece of the puzzle that needs to be determined is some indication of the type of distribution pattern shown by Alberta's curlew population. For example, are they evenly distributed over areas of favourable habitat, randomly distributed or clustered?

The sparse information that is available for Alberta and Saskatchewan suggests that they may be clustered (DeSmet 1992, Hill 1998). In his Washington study, Fitzner (1978) found that curlew breeding territories are frequently clumped in loose aggregations. This presents interesting problems in selecting a sampling design (Thompson et al. 1998).

In Saskatchewan, the data from Al Smith's 1988 survey suggests that curlew distribution may be clustered. From her recent study in western Saskatchewan, Janna Foster (pers. comm.) found that curlew distribution appeared to be clustered, almost in "social clusters", as she describes them.

In the pipeline data in the BSOD database, curlew distribution again appears "clumped". There are areas of native grassland where no curlews were observed and other areas where there appeared to be concentrations of curlews. However, without knowing how the survey was conducted, it is difficult to draw any conclusions from this.

Alberta Survey Recommendations

- *Because of the apparently clustered nature of the curlew population in Alberta, we can anticipate a high variance among the sample units. Therefore it will be important to have a large number of sample units that should be relatively large in order to maintain a suitable degree of precision.*

- *For future management purposes, it will be important to determine where the concentrations or "curlew clusters" are in Alberta.*

3.7 Identification

The discrimination of both sexes and age classes will likely be important when conducting surveys. Fortunately curlews are sexually dimorphic. The females have a bill that is more than three times the length of the head. The male bill is three times or less the length of the head. The male bill has a more perfectly symmetrical curve whereas the female bill is more flat on top with a more pronounced curve towards the tip (Allen 1980). Apparently this method of identification is somewhat simple to use and therefore the sexes of individual birds should be

able to be recorded in a survey. However Paulson (1993) cautions that the bill distinction can be difficult to use in field identification as longer-billed males and shorter-billed females probably have bill shapes approaching those of the other sex.

Juveniles can be distinguished from adults. They have a noticeably shorter bill length compared to adults. Also, the streaks on the neck are fewer and less pronounced (narrow and smaller) in juvenile plumage (Allen 1980). The breasts of juveniles are completely unstriped, unlike adults that are conspicuously striped. Juvenile plumage is more rufous than adult breeding plumage (Allen 1980). It would be valuable to record juveniles separately in any survey done in Alberta. This might help to fill the information gap regarding whether juveniles migrate to Alberta or stay on their wintering grounds.

Interestingly, curlew bills continue to grow for some time after maturity (Taverner, 1934)

Alberta Survey Recommendations

- *Include information on curlew identification when training field observers, so that as much as possible they are able to distinguish male and female curlews in the field.*

4.0 SURVEY METHOD AND DESIGN FOR AN INVENTORY OF THE LONG-BILLED CURLEW POPULATION IN ALBERTA

4.1 Inventory Objectives

The primary objective of the inventory to be carried out in 2001 is to estimate the population of long-billed curlews in Alberta to within ±20% of the actual population (R. Quinlan, pers. comm.). The methodology should also lend itself to being able to identify population trends over time, with future repetitions of the survey. A secondary objective is to sample other prairie species that can be easily observed and recorded within the sampling framework designed for curlews.

An inventory of curlews in Alberta is being conducted for the following primary reasons (R. Quinlan pers. comm.):

1. Currently there is little existing scientific data about the long-billed curlew in Alberta. In order to better determine the status of the curlew in Alberta an estimate of the number of individuals is required. This inventory is a necessary first step towards implementing management strategies for the long-billed curlew in Alberta.

2. An inventory will provide baseline data that can be used to help wildlife managers track trends in the Alberta population over time.

3. A ministerial action statement was issued in 2000, listing the long-billed curlew as a priority species for a province-wide inventory.

4. The Alberta status report on the long-billed curlew (Hill, 1998) recommended "effective management of Long-billed Curlews in Alberta relies upon the implementation of systematic population surveys".

An accuracy of ±20% was chosen because the more precise the population estimate is, the more useful the results are. However given the large land base contained in the Grasslands Natural Region, and the small window for surveying curlews, it is unlikely that a precision of greater than ±20% can be achieved. The survey may ultimately achieve a lower precision than ±20%, but ±25% or ±30% would still yield useful information.

4.2 Sampling Design

Obviously it would be impractical to inventory the entire grassland region of Alberta in order to estimate the curlew population, thus sampling units must be defined and a sampling design developed. To achieve a statistical precision of ±20%, it will be especially important to minimize the variance between the sampling units. High variances between sample units will result in decreased statistical precision. This was the primary problem in the Saskatchewan survey (A. Smith, pers. comm.).

One of the best ways to minimize variance in a sample, and therefore increase precision, is to stratify the sample (Krebs 1989, Thompson et al. 1998). As we have some existing information on the habitat preferences of curlews, as well as an inventory of native prairie in Alberta, stratification based on habitat (in terms of the percentage of native prairie) is possible.

With the assistance of Natural Resource Services GIS technician (S. Pinder), it was possible to examine the relationship between percent native prairie (from the Alberta Native Prairie Database) and curlew observations in the Biological Species Observations Database (BSOD). To do this we took the native prairie information for quarter sections and created a coarser scale by averaging the percent native prairie on a township basis. The quarter section scale was not used because it would be too fine a scale. During the breeding season curlews range considerable distances, and use considerably more land than is included in one quarter section. Also, when each observation was examined we found that those occurring in quarter sections with no native prairie were always within at least 2km of a native prairie parcel. The township scale was also selected for practical reasons: Township boundaries were an existing layer in the GIS database (the next smallest boundary was the quarter section). A resolution at the township scale creates large enough areas of the same strata that allow the accommodation of appropriately sized sample units for sampling curlews (see the next section, 4.3, for a discussion of sample unit size). A smaller resolution (i.e. in between the township scale and quarter section scale), if it had been possible to create, would likely have produced a very patchy strata distribution and it would have been difficult to locate appropriately sized sample units within the same strata.

A variety of maps were created, based on different classes of percent native prairie. The class divisions that showed the closest relationship with the BSOD curlew observations and seemed to best fit curlew habitat preferences were: 0-5% native prairie, 5-50% native prairie and 50-100% native prairie. It is hoped that sampling within in each of these three classes will result in lower overall variance than if the region was sampled as a whole. It is expected that surveys within the 0-5% class will reveal no or very few curlews. The 5-50% class should contain more curlews, but likely not in large numbers. The 50-100% class will likely contain the largest numbers of curlews. These classes are shown in Figure 5 and the area represented by each class is show in Table 3.

Figure 5: Native Prairie Classes and BSOD Curlew Observations

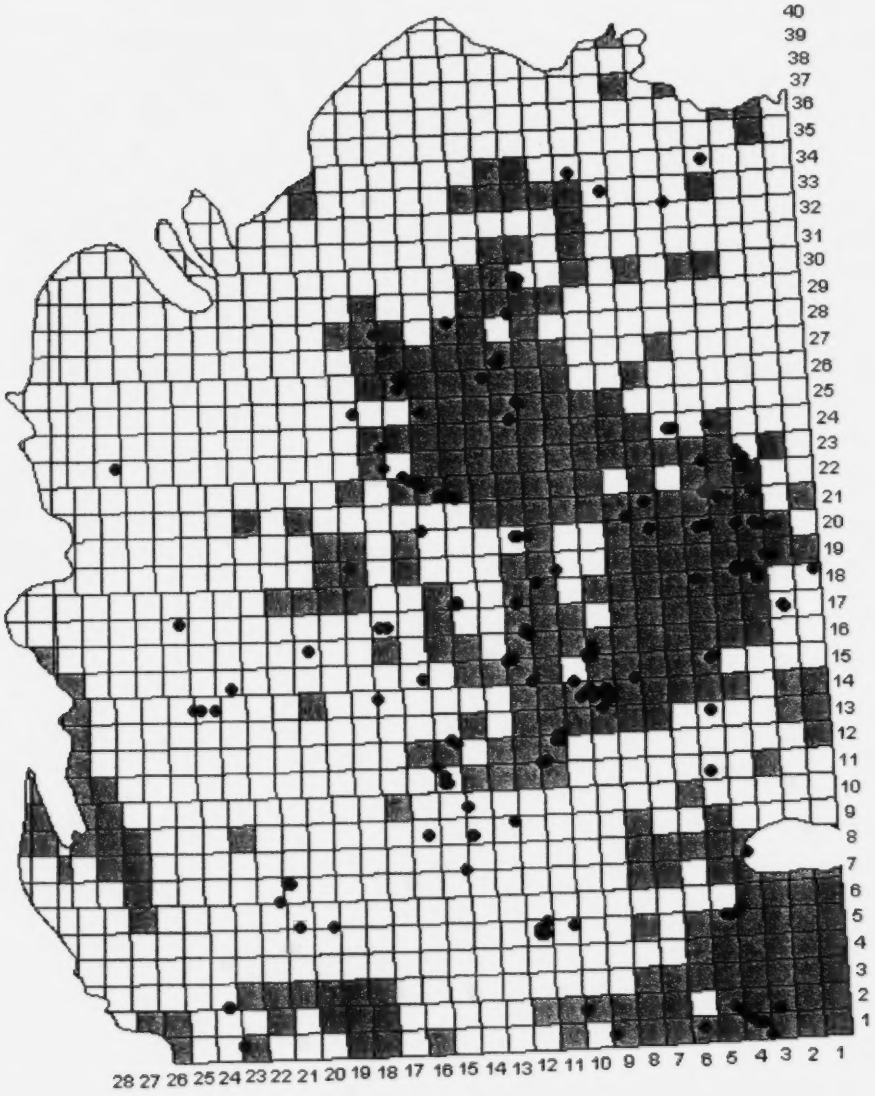


Table 3: Area Represented by each Native Prairie Class

	Class	Number of townships	Area	Percentage of study area
	0-5%	188	17,326 square km	17%
	5-50%	578	53,268 square km	53%
	50-100%	326	30,044 square km	30%

Within these classes at the township scale, only 13 of the BSOD observations were in townships with 0-5% native prairie. 55 observations were in townships with 5-50% native prairie and 150 observations were made in townships with 50-100% native prairie.

Again it should be noted that the BSOD data must be used with caution because most of the BSOD curlew observations were incidental observations from studies being conducted in native prairie, thus the data are likely biased towards observations in or near native prairie areas.

Sampling Design Summary

- *The Curlew inventory will be conducted in the Grasslands Natural Region (sampling frame).*
- *The sampling frame will be divided into three strata, based on the average percentage of native prairie in a township (0-5%, 5-50% and 50-100%).*
- *Within these strata, sample units will be randomly selected, without replacement.*
- *The Cypress Hills plateau, cities and towns will be excluded from the sample frame (curlews are not found in the Cypress Hills plateau, Renaud 1980).*

4.3 Size and Shape of Sample Units

To select the most appropriate size and shape for individual sample units, the following criteria were developed:

Sample units must:

- Have boundaries and start/end points that are easily determined and found on the ground.
- Have boundaries and start/end points that can be identified on a topographical or municipal map.
- Be able to be surveyed in one morning or less (3 – 4 hours).
- Be at the very least 7 square kilometers in size, but preferably much bigger.
- Minimize the number of zero curlew counts or unusually high curlew counts.
- Be feasible in both areas of native grassland and cultivation.
- Minimize landowner contacts where possible (to reduce the amount of staff time spent on landowner contacts and therefore reduce the overall cost of the inventory).

Sample units could be square blocks, rectangular blocks or transects (which are essentially long thin rectangular blocks). Tables 4 and 5 show some of the possible sizes and shapes for curlew sample units as well as the most suitable transportation method, degree of coverage and level of landowner contacts required.

Table 4: Area Options for Sample Units

Area Options	Shape	Size	Details	Coverage of area	Landowner Contacts
4 Sections	Square	10.35 km^2	Search area by combination of vehicle, foot and possibly bike	Good	Moderate (depends on availability of roads)
8 Sections	Square	20.7 km^2	To cover this in one morning, would have to be done mostly by vehicle	Fair	Moderate - Low
16 Sections*	Square	41.4 km^2	Would have to be done entirely by vehicle	Poor	None
4 Sections	Rectangle (1.6 km x 6.4 km)	10.35 km^2	Search area by combination of vehicle, foot and possibly bike	Good	Moderate (depends on availability of roads)
8 Sections	Rectangle (1.6 km x 12.8 km)	20.7 km^2	To cover this in one morning, would have to be done mostly by vehicle	Fair	Moderate - Low
16 Sections	Rectangle (1.6 km x 25.6 km)	41.4 km^2	Would have to be done entirely by vehicle	Poor	None

Table 5: Transect Options for Sample Units

Transect Options (500m width each side)	Transect Length	Area	Details	Coverage	Landowner Contacts
Bike Transects	20 – 30 km	20 – 30 km^2	Use minor roads (mostly gravel) where possible, in areas with few roads, will have to do some off-road transects	Good	Moderate (only in areas with few roads)
Walking Transects, along roads	10 – 15 km	10 – 15 km^2	Use minor roads (mostly gravel) where possible, in areas with few roads, will have to do some off-road transects	Good	Moderate (only in areas with few roads)
Walking Transects, off-road	10 – 15 km	10 – 15 km^2	Start transect from road, walk perpendicular to road	Good	High (for all transects)
Vehicle Transects	40 – 50 km	40 – 50 km^2	Try to use minor roads where possible. Could use ATVs where there are few roads	Fair (less in areas where few roads)	None (unless ATVs are used in areas with few roads)

Square blocks have the advantage of minimizing edge effects (particularly the number of times that observers need to decide if an observation is inside or outside the survey unit). However these effects can be reduced by ensuring that the observers are well trained in distance estimation and by developing well-defined survey protocols. Square and rectangular plots increase the risk of double-counting birds, especially as curlews tend to come in from considerable distances to mob a predator.

Transects (essentially long, thin blocks) can reduce the chances of double-counting birds. They are also more appropriate for clumped populations as you are more likely to run into a clump (Krebs 1989, Thompson et al. 1998). Because Alberta's curlew population appears to be clumped, it is recommended that transects (long thin blocks) be used versus square or fat rectangular blocks.

One concern with using transects based on roads and right-of-ways is the potential influence of the roads on the results. This is discussed further in section 4.12.

The use of transects versus blocks is supported when we compare results from the Saskatchewan curlew survey (based on 16 section square blocks) with the Grassland Bird Monitoring Program (GBMP) conducted by Canadian Wildlife Service (B. Dale, pers. comm.). The GBMP uses 40km long driving transects. The curlew data from the pilot project (B. Dale, unpublished data) reveals a lower variation than was found in the Saskatchewan Study (Table 6).

Table 6: Comparison of results from Saskatchewan curlew survey and grassland bird monitoring program.

Study	Sample Unit Shape & Size	Year	Number of sample units	Mean	St. Dev.	Coefficient of Variation
Saskatchewan Curlew Survey	Square, 16 sections	1989	120	1.22	3.39	2.787
Grassland Bird Monitoring Program	Transects, 40km x 1km	1996	19	5.63	6.61	1.174
GBMP	Transects, 40km x 1km	1998	8	10.13	9.98	0.985
GBMP	Transects, 40km x 1km	2000	5	9.8	8.5	0.867

Sample Unit Summary

- *Long thin sample units (transects) will be used (40km by 1km).*
- *Transects will be established along roads or other right-of-ways as much as possible and surveys will be conducted by driving the transect and getting out of the vehicle to record data. In areas where roads are sparse, some transects will be conducted off-road using either quads or mountain bikes.*

4.4 Number of Sample Units

Ideally a pilot project should be conducted in order to best determine both the ideal sample unit size and the number of sample units required. As this is not possible, the final determination of the number of sample units will have to be calculated while the data are being collected. However, some broad estimates can be made, based largely on the data collected from the GBMP. Table 7 shows the number of 40 km survey routes that would be required to obtain a precision of ±20% based on the data from the GBMP.

Table 7: Number of Sample Units Required to Obtain a Precision of ±20% (based on data from Grassland Bird Monitoring Program – B. Dale unpublished data)

N	Year	Length of Transect (km)	Mean	Standard Deviation	Coef of Var	Number of Units Required*
19	1996	40	5.63	6.61	1.174	138
6	1997	40	9.67	9.56	0.989	98
8	1998	40	10.13	9.98	0.985	97
5	2000	40	9.8	8.5	0.867	75

* based on Krebs (1989), using $n = (200CV/r)^2$ (where n = sample size, CV = coefficient of variation and r =desired relative error). Assuming 95% confidence limits, where $t_\alpha=2$.

Considering that the GBMP is not stratified by percent native prairie (it is stratified in that only degree blocks containing substantial amounts of grasslands were selected), we can hope that for the Alberta curlew inventory we will require approximately 80 and 100 survey transects in order to achieve ±20% precision. This is a fairly conservative estimate, and it may be that fewer are required, especially if no curlews are found in the 0-5% native prairie strata (in which case, surveys will be ceased in that strata after 10 – 15 sample units have been completed). Once the survey is underway, calculations of the mean, standard deviation and number of units required will be made after every 10 surveys are conducted.

Number of Sample Units Summary

- *It is estimated that between 80 and 100 sample units will be required. It is possible that fewer will be required, depending on the amount of variation found in each strata.*
- *Calculations of precision and number of survey units required will be made during the data collection period, after every 10 surveys.*

4.5 Sample Unit Selection

Thirty sample units were selected in the 0-5% strata and forty each in the 5-50% strata and 50-100% strata. It is quite possible that not all selected units will be used in the survey. The following process was performed to select sample units in each of the three strata:

1. A list of all the townships in the strata was generated using ArcView and the Native Prairie Database.

2. The townships were numbered in an Excel worksheet. Unique random numbers were assigned to each township and then the lowest sixty numbers were selected, giving sixty randomly selected townships. Sixty were chosen initially as some would eventually be discarded (for example, where they are completely surrounded by different strata).

3. For each of the selected townships, 40km* of minor road (i.e. not a highway) was selected with the following rules;
    - As much of the transect as possible should run in the same compass direction for the whole 40km.
    - As much of the route as possible should be in the selected township (for example, preferably 9.6 km of the transect should be in the selected township).
    - The starting point of the transect is the end closest to the originally selected township.
    - The start point should be easy for field observers to locate (for example, at an intersection or other landmark).
    - Where it is not possible to locate at least a 30km* route without running into a different strata, abandon that township and re-select.
    - Where there are no roads in a township, the nearest access point was located and an off-road (20km) transect was established.
    - Parallel transects must be at least 2km apart from each other and intersecting transects should be avoided as much as possible.

    *In the 50-100% native prairie class it was frequently difficult to find 40km of continuous transect. Rather than discarding that township, a shorter transect was established (but not less than 30km). Shorter transects will be accounted for appropriately in the data analysis.

4. Each transect was named using three numbers. The first digit indicates strata, the second two digits indicate the order in which it was selected (for example, "1-05" indicates the fifth selected transect in strata 1). Transect numbers were entered into a spreadsheet, as well as the following information; UTM coordinates for the start point, closest settlement, and any descriptive comments as needed (for example, indicating jogs, potential rough roads, landmarks and so on).

5. The transects were drawn on a 1:250,000 map, with start and end points and transect names indicated. A copy of each transect map was made for field use.

6. Once a township has been selected, it cannot be selected again (i.e. sampling without replacement).

Sample Unit Selection Summary

- *Townships in each of the three strata were selected in an unbiased manner*
- *Within the selected townships, sample units were chosen based on a set of rules and marked on 1:250,000 maps*

4.6 Scheduling Sample Unit Surveys

To ensure that there is no bias in sampling time across the study area (for example, all northern routes are sampled in the first half of the sampling window), the order in which routes are sampled was determined in advance, in an unbiased manner. To do this, but still maintain some efficiency in travel times, the study area was divided into 6 similarly sized sectors (loosely based on map sheets in the grasslands natural region):

	1	2	3
1			
2			
3			

The following steps were followed to select the order in which sample units are surveyed:

1. Randomly select a row and randomly select a column in order to select a sector.
2. Within that sector, randomly select two sample units from each strata (giving a total of six sample units).
3. These six routes will be the first to be surveyed. In most circumstances, a team of two people will spend three days in that sector to complete the six routes.
4. The process was repeated, without replacement, until all nine sectors had six routes assigned.
5. Repeated the entire process until all routes had been scheduled.

Order of Sample Unit Surveys Summary

- *The order in which sample routes are surveyed has been predetermined and selected in a unbiased manner.*
- *The scheduling process takes into consideration the importance of minimizing travel time and thus maximizing efficiency.*

4.7 Resources for Conducting the Inventory

4.7.1 Human Resources

Each curlew sample unit will require one person-day for reconnaissance, habitat data collection, actual survey and data input. Assuming that between 80 and 100 sample units will be required to complete the inventory, then 80 – 100 person days will be needed for field work. Some Natural Resource Services staff will be conducting surveys, as well as the project coordinator. Assuming that these people will collectively conduct 24 surveys, field staff will need to be hired to cover approximately 56 – 74 surveys.

Because field staff are most likely to be students, who can't begin until after exams, the earliest that training could take place would be the week of April 23rd-27th. Field surveys could start on April 30th. This gives a window of 40 days (to June 8th) or 47 days if extended to June 15th. If it is assumed that one third of these will be poor weather days, this leaves between 27 and 31 days. Therefore considering days off, it would be fair to expect that a field staff person could realistically do at least 20 surveys each (a conservative estimate), possibly as many as 25 or more surveys each (probably towards the maximum). If the weather is cooperative, it could possibly go up to as high as 30 per field worker (but knowing southern Alberta weather, this seems unlikely).

Table 8 shows the number of surveys that could be conducted within the range of 20 to 25 field days with both three and four field staff.

Table 8: Number of Surveys that can be Conducted with Three and Four Field Staff

	Assuming only 20 days per field staff (3 staff)	Assuming 25 days per field staff (3 staff)	Assuming only 20 days per field staff (4 staff)	Assuming 25 days per field staff (4 staff)
NRS Staff	20	20	20	20
Project Coordinator	4	4	4	4
Field Staff	60	75	80	100
Total Possible Surveys	**84**	**99**	**104**	**124**

As Table 8 shows, the number of surveys that could be conducted ranges from 84 to 124 (all within the range of 80 – 100 surveys), but the three staff option leaves very little flexibility in the case of bad weather and it would be very unlikely that additional studies (within-site variability or influence of roads – see sections 4.11 and 4.12 below) could be conducted in this scenario. Thus, it is recommended that ideally four field staff be hired to conduct the curlew surveys.

4.7.2 Physical Resources

Each surveyor will require a vehicle in order to conduct the surveys, as well as a GPS unit and high quality binoculars. As the sample units are spread out across the whole Grasslands Natural Region, accommodation will need to be provided when conducting surveys away from where staff are based.

Resources Summary

- *In addition to NRS staff, a minimum of three, preferably four, field staff will need to be hired for this project from late April to mid-June.*
- *Physical resources that will be required include one vehicle per field observer, GPS units, binoculars and accommodation.*

4.8 Survey Methods & Protocol

The surveys will be conducted while curlews are on their breeding territories, between April 25th and June 8th. It may be possible to extend surveys to as late as June 15th. As females are on their nests during the day, the survey will primarily be sampling breeding males. Sampling will be performed between one half hour before sunrise and approximately three to four hours after sunrise. Inclement weather will be avoided (high winds, rain, snow etc.). Observers will be required to drive their route the day before the survey, to ensure they know where they are going before the survey begins. On this reconnaissance run, basic habitat data and GPS locations will be collected at each stop.

On each transect, observers will stop every kilometer and for five minutes:

- Record any curlews heard or seen, including distance from observer when first observed (<500m from centre line, 500 – 1000m, >1000m) and direction of observation (north, south, east or west).
- For each curlew, record sex (if determined), age (adult or juvenile) and behaviour.
- Record incidental species as observed (see section 4.10 below).

Field survey forms for habitat and curlews are given in Appendix B. Detailed instructions for completing data forms and for entering data are given in Appendix C.

Survey Protocol Summary

- *Prior to the surveys being conducted, observers will drive the route and record habitat and GPS data.*
- *Surveys will be conducted between one half hour before sunrise and three to four hours after sunrise.*
- *Observers will stop every kilometer and record the following information for five minutes; location of observed curlews, sex, age and behaviour, incidental species.*

4.9 Training Field Observers

Three to four field observers will be hired specifically for this project (see section 4.7 for discussion of resources). As well, some additional Alberta Natural Resource Services staff will participate. All field observers participating in the curlew inventory, including Natural Resource Staff, must attend a training workshop. They will be given a basic knowledge of curlew biology, including behaviour and identification (by sight and sound). They will be oriented to the structure of the sample units and given instruction on how to complete the surveys and enter data. There will also be instructions on how to use the GPS units. Training in distance estimation will be a critical part of the orientation for observers. As part of the training, test routes will be run, using curlew cutouts.

Training Summary

- *All field observers will receive formal training on the survey techniques, curlews, incidental species, GPS operation and distance estimation.*

4.10 Incidental Species

The curlew inventory presents an opportunity to collect data on other prairie wildlife species. However it is important not to overwhelm observers with collecting incidental observations and compromise the curlew survey. Therefore only a few incidental species will be targeted. The following six species have been selected on the basis of their detectability during the survey period, their species at risk status, and the fact that they are found in the Grasslands Natural Region. Observations of these species will be recorded directly on the curlew data forms:

- Ferruginous Hawk (Special Concern in Canada, blue-listed in Alberta)
- Burrowing Owl (Endangered in Canada, red-listed in Alberta)
- Short-eared Owl (not listed in Canada, blue-listed in Alberta)
- Upland Sandpiper (not listed in Canada, yellow-listed in Alberta)
- Sprague's Pipit (Threatened in Canada, blue-listed in Alberta)
- Loggerhead Shrike (Threatened in Canada, yellow-listed in Alberta)

In addition to this, observers will be asked to record any observations of the following species (considered at risk, sensitive or lacking in information). Observations of these species can be recorded both during and out of the regular survey period.

Mammals

- American Badger
- Swift Fox
- Thirteen-lined Ground Squirrel
- Bobcat

Herptiles

- Prairie Rattlesnake
- Hognose Snake
- Great Plains Toad
- Northern Leopard Frog
- Canadian Toad
- Plains Spadefoot

Birds

- Sage Grouse
- Peregrine Falcon
- Golden Eagle
- Piping Plover
- Mountain Plover
- Sage Thrasher
- Baird's Sparrow

All production sites (nests, dens, breeding ponds etc.) will be recorded and will require the observer to provide a GPS location. All observations collected during this survey will be entered into BSOD. The form for recording incidental species is given in Appendix B.

Incidental Species Summary

- *Abundance information on six prairie bird species will be collected in sample units directly in conjunction with the curlew inventory.*
- *Occurrence information on an additional sixteen prairie wildlife species will also be collected when observed both on and off of surveys.*

4.11 Within-site Variation

With most surveys of animal populations, there is a degree of within-site (sample unit) variance. In other words, replicating the survey in the same sample unit will usually yield different results. It is possible to estimate of the amount of within-site variation by conducting replicate surveys of the same sampling unit/s during a short time period (Link et al., 1994). If this source of variation is large, it can be incorporated into the data analysis.

To measure the degree of within-site variation in the curlew inventory, a minimum of three sample units would need to be selected in each of the strata (i.e. 9 sample units in total). For statistical analysis, it would be preferable to have more (i.e. 4 – 5) in each strata. Each sample unit should be sampled for a minimum of three days in a row (again, 4 – 5 replicates per route would be preferable). If the minimum were done (9 units, each sampled 3 times) it would result in a total of 36 surveys, only 9 of which would actually contribute directly to the curlew inventory. Therefore 18 additional person-days would be required in addition to the inventory-based fieldwork, plus an extra day or two for analysis of these data. Although this type of study may be useful, it is likely not feasible given the resources available and the short time window for collecting curlew data. It should be noted that within-site variation is usually less in studies designed specifically for one species (because the methods are oriented specifically towards detecting one type of bird) versus general surveys like the Breeding Bird Survey (Link et al., 1994). Link et al. also found that in most wildlife population studies, in order to reduce overall variability, it is usually more efficient to initiate new sites rather than to replicate existing sites.

4.12 Assessing the Influence of Roads

Because most of the sample units are along roads, roads will no doubt influence both data collection (for example, interference with observers by other vehicles on the road) and curlew density and distribution (for example, perhaps curlews nest in lower or higher densities near roads). As sample units were selected, an effort was made to use minor roads as much as possible, in order to minimize any effect of roads. It would be valuable to assess the influence of roads on the survey technique. If resources are available, a separate study could be conducted to compare roadside surveys, conducted as part of the inventory, with off-road surveys.

A suggested methodology for this study is outlined below:

- Randomly select minimum of nine sample units (three in each strata), preferably fifteen, for increased statistical power.

- Within each of the selected sample units, choose 10km of straight-line road (i.e. no turns).
- *Only where the habitat is the same*, establish a parallel, off-road, transect of 10km length, 1 mile away from the road transect (i.e. in most cases, two fence-lines away. The direction of this off-road transect should be randomly selected (for example, east/west or north/south depending on the orientation of the transect). Obviously where this falls on another road, it should be discarded and another one selected.
- Ideally this survey would be done on the same morning and at the same time as the road survey on the adjacent sample unit, but either on foot or using a bicycle or ATV.

The results could then be compared with the results from first 10km of road survey to give an indication of the influence of roads on the overall inventory.

If fifteen sample units were selected for this treatment, this would add fifteen person-days of field work, plus additional time for landowner contacts. Assuming five days for landowner contacts, a total of twenty person-days would be required in addition to the regular inventory. There would also be some additional time required for data analysis and interpretation of results.

Another aspect of the inventory that possibly could be tested in conjunction with this is a determination of the proportion of the curlew population that is being recorded using the inventory methods. The person conducting the off-road survey could conduct two separate surveys while traversing the transect: Firstly, map curlews in a detailed fashion while walking/cycling the transect. Secondly, the observer records curlews separately at each formal 1km stop, using the standard inventory methods and form (i.e. for 5 minutes, record curlews in set distance bands). It will then be possible to compare the results of mapping individual curlews while traveling with those collected only at the formal stops for 5 minutes. This may give an indication of the proportion of curlews that are being "missed" during the formal surveys.

It is recommended that if resources are available, that this study be a priority (versus within-site variability). Even if specific resources are not available directly for this study, if the inventory season proceeds well, with few weather-related delays and/or only a minimal amount of surveys are required in one of the strata (e.g. the 0-5% native prairie strata), then it may be possible to include this study towards the end of the inventory period. Alternatively, this study could be conducted separately in a subsequent year.

4.13 Data Analysis

From the results of the curlew surveys, using the number of curlews observed within 500m of the centre line of each transect, a curlew density will be calculated for each of the three strata. Knowing the area of each of these strata in Alberta, it will be possible to extrapolate the density data into a population estimate. It should be remembered that as some curlews will undoubtedly be missed during surveys, that the population estimate will most likely represent the minimum population size.

4.14 Assessing Long-term Trends in the Curlew Population

Because of the resources and expense involved in conducting this inventory, obviously it would not be practical to repeat the entire process every few years.

When another survey should be conducted will depend in part on the population estimate from the 2001 inventory. For example, if the population is found to be alarmingly low, there may be a need to repeat the survey, or parts of it, in 2002. Conversely, if a relatively large, healthy population is found, then it likely won't be necessary to re-inventory the population for at least five years.

The Grassland Bird Monitoring Program will be an extremely useful tool to allow wildlife managers to keep a "finger on the pulse" of the curlew population on a yearly basis. Apparently two GBMP routes will, with 80% power, detect a three percent per year decline over ten years (B. Dale pers. comm.). Any dramatic changes (particularly in a negative direction) may necessitate the repetition of the overall curlew inventory, or parts of it.

If a repeat of this inventory is done, rather than repeating all survey routes, a sub-sample could be taken to give an indication of population change. If approximately thirty percent of the routes in each strata were re-sampled (selected, of course, in an unbiased fashion) it should provide enough data to be able to draw statistical conclusions about population changes. The actual decisions regarding re-sampling will depend in part on the results of the 2001 survey (for example, if no curlews or fewer than ten percent of the curlew population are found in Strata 1, it is probably not worth re-sampling that strata as the information gained on population trends would be minimal). If thirty percent of routes were re-sampled, this would total approximately 25 – 30 routes, which realistically could be performed by one field person during the survey window. Therefore, only one staff person would need to be hired for the period of late April to mid-June in order to re-sample thirty percent of the curlew sample units. It is important that if this re-sampling is done, that each unit is re-sampled during approximately the same time period that it was sampled in 2001.

5. SUMMARY OF INVENTORY METHODS

The following summarizes the methods that will be used to estimate the number of long-billed curlews in Alberta:

1. The Curlew inventory will be conducted in the Grasslands Natural Region (sampling frame).
2. The sampling frame will be divided into three strata, based on the average percentage of native prairie in a township (0-5%, 5-50% and 50-100%).
3. Within these three strata, sample units will be randomly selected, without replacement.
4. The Cypress Hills plateau, cities and towns will be excluded from the sample frame.
5. Long thin sample units (transects) will be used (40km by 1km).
6. Transects will be established along roads or other right-of-ways as much as possible and surveys will be conducted by driving the transect and getting out of the vehicle to record

data. In areas where roads are sparse, some transects will be conducted off-road using either quads or mountain bikes.

7. It is estimated that between 80 and 100 sample units will be required. It is possible that fewer will be required, depending on the amount of variation found in each strata.
8. Calculations of precision and number of survey units required will be made during the data collection period, after every 10 surveys.
9. At least 30 townships in each of the three strata were selected in an unbiased manner.
10. Within the selected townships, sample units were chosen based on a set of rules and marked on 1:250,000 maps.
11. The order in which sample routes are surveyed has been predetermined and selected in an unbiased manner.
12. The scheduling process takes into consideration the importance of minimizing travel time and thus maximizing efficiency.
13. In addition to NRS staff, a minimum of three, preferably four, field staff will need to be hired for this project from late April to mid-June.
14. Physical resources that will be required include one vehicle per field observer, GPS units, binoculars and accommodation.
15. Prior to the surveys being conducted, observers will drive the route and record habitat and GPS data.
16. Surveys will be conducted between one half hour before sunrise and three to four hours after sunrise.
17. Observers will stop every kilometer and record the following information for five minutes; location of observed curlews, sex, age and behaviour, incidental species.
18. All field observers will receive formal training on the survey techniques, curlews, incidental species, GPS operation and distance estimation.
19. Abundance information on six prairie bird species will be collected in sample units directly in conjunction with the curlew inventory.
20. Occurrence information on an additional sixteen prairie wildlife species will also be collected when observed both on and off of surveys.

6.0 PERSONAL COMMUNICATIONS

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8.0 APPENDICES

Appendix A
Results of Literature Search

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Appendix B
Field Survey Forms

Long-billed Curlew Inventory 2001

Habitat Field Form

Sample Route Number: _____

Date Completed:_____ Completed By:_____

Data Entered on: _____

By: _____

Spreadsheet Name _____

Enter "100" in one box or "50" in two boxes (where habitat differs on either side of the transect). On very rare occasions you may have to enter "25" in four boxes.

Additional habitat notes can be recorded on the back

Stop	Native Grassland		Tame Pasture		Cultivated		Riparian		Other	Northing	Easting
	Ungrazed	Grazed	Irrigated	Dryland	Irrigated	Dryland	Lentic	Lotic	Please describe:		
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
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Long-billed Curlew Inventory 2001

Curlew Field Form

Survey Route Number: _____
Observer: _____
Start Time: _____
End Time: _____

Weather Information:
Calm Light breeze Moderate breeze Windy
Sunny Partially overcast Overcast
Temperature Start ____C Temperature End ____C
Light Rain Light Snow
Other: _____

Odometer Reading at Start:

Data entered on:_____
Data entered by:_____
Excel Filename: _____

Long-billed Curlews

Behaviour when first observed

STOP #	Location 1=0-500 2=500-1000 3=>1000 North, South, East, West		Sex undeterm. male female	Age adult juv.	Behaviour Flying, Forage, Standing, Defensive, Incubating	Habitat Ngrass, Tpasture, Cult, Rip	Comments

Incidental Species

FeHa		ShOw		BuOw		UpSa		LoSh		SpPi	
dist	#	dist	#	dist	#	dist	#	dist	#	dist	#

Long-billed Curlew
Inventory 2001

Incidental Species Form

Species Abbrev.	Location*	Date	Observer	#	BR/OB	CO/PR	Details (location of production sites, etc.)

BR = Breeding
OB = Observed (no direct evidence of breeding)

CO =Confirmed breeding (nest, feeding young)
PR = Probably breeding
G = General (not breeding

*give survey route number and stop if observed on a route, plus GPS location

Appendix C
Instructions for Data Collection and Data Entry

CURLEW INVENTORY
Instructions for Data Collection & Data Entry

ROUTES
All routes are 40km in length. Along each route there are 40 stops, spaced 1 km apart. Curlew and habitat data will be collected at each of the 40 stops. Routes are being run in three different strata;

STRATA 1 = 0-5% native prairie
STRATA 2 = 5-50% native prairie
STRATA 3 = 50-100% native prairie

The native prairie information is based on Alberta Environment's Native Prairie Database, a GIS-based database compiled from aerial photography.

Route identification numbers are four digits in the format "x-xx". The first digit is the strata number, the second digit is the route number. For example the 3rd survey route in the 0-5% native prairie stratum will be numbered 1-03. There is a reference list specifying route numbers and the UTM coordinates of the starting point.

DATA COLLECTION

STEP 1. Familiarization with your route & habitat data collection

Prior to conducting the actual curlew survey, drive your survey route in advance (most likely the day before). Collect habitat data for your route at this time (not during the curlew survey) using the HABITAT FIELD FORM. This data will be used to gain a better understanding of curlew habitat preferences. Information from repeat surveys will also help us to detect any changes in habitat over time.

At each stop record the habitat type AT THAT STOP. In many places you will probably find that the habitat is the same on both sides of the road, in which case simply enter "100" in the appropriate box. As most of the routes are along roads, you will likely run into the situation where the habitat is different on each side of the road. Simply place "50" in the two relevant boxes. Very occasionally you may find your stop falls at an intersection of four fields, each with a different habitat. In this case, enter "25" in four boxes.

At each stop you must also collect the GPS coordinates and enter them on the habitat field form.

STEP 2. Curlew Survey

Timing
Be at the start of your route and ready to start collecting data 30 minutes before sunrise.

Weather
Do not conduct the survey in high winds*, moderate rainfall or snowstorm conditions! If any of these conditions start part-way through a survey, you will have to stop. You will have to use your judgment on this. If you feel that the weather conditions are in any way hampering your ability to hear or see curlews or that curlews are "lying low" because of the weather conditions, then do not conduct the survey.
* >30km/hr

Curlew Field Form
Before you start your survey, fill in the general information at the top of the field form. It is very important that you record your odometer reading. That way you can always figure out what stop you are at, incase you lose track.

For each individual curlew observed, you must complete a row on the field form. Record the distance band it was in **when you first observed it**. Record it's gender (if in any doubt, record as undetermined – I expect many of our sightings will fall into this category). Record behaviour when first observed.

If you observe any of the 6 priority incidental species, you must record them on the curlew field from at the appropriate stop number. For each incidental species, record which distance band you first observed it in (i.e. 1, 2 or 3). In the # column, enter the number birds seen. At this time of year you likely won't be seeing fledged young, so we are not recording adults versus young. As none of these species are sexually dimorphic, you will not be able to tell their sex by sight. However for the loggerhead shrike and Sprague's pipit the male is the only one that sings. Please indicate if the birds appear to be part of a pair by using "P". For example if you see two ferruginous hawks that are perched close together, are courting or other indication that they are a male-female pair, you would enter "2P" in the # column. If you hear one Sprague's pipit singing, you would enter 1M (for 1 male) in the 3 column. I will assume that any bird without an "M" or "F" after it, was of undetermined sex.

At the end of your route, please record the temperature again and the time your survey was completed by.

Recording Other Incidental Observations

The incidental species list is on the back of the Incidental Species Form. Fill in a separate line for each incidental species observation (groups of birds seen at the same time and location can be entered in the same line). This form should be used for:

1. Observations made during the curlew survey route of any of the incidental species that are NOT one of the 6 priority species (as these will be entered on your curlew field form)
2. Observations of any of the incidental species INCLUDING the 6 priority species made off of the formal surveys (e.g. while traveling to and from routes, while collecting habitat data etc.).

UTM coordinates must be given for any production sites (nests, dens, breeding ponds).
NAD 83 and decimal degrees are the standard.

DATA ENTRY

Do not discard original data sheets even after you have entered the data into spreadsheets. All original field data sheets must be kept and returned to Liz.

Ideally you should enter your data as soon as possible after you have collected it.

In each curlew and incidental species worksheet, the ID numbers are for reference purposes only – you cannot change them. This way each individual observation will have its own unique ID number (route number plus ID number e.g. 1-002-132). This may come in useful later – for example if Liz has a question about a particular sighting (i.e. "please give me more details on observation 132 on route 1-003")

Habitat Data Entry
Each workbook is set up to contain the data for 20 routes & a summary of the 20 routes
Liz will compile the overall data as the spreadsheets come in.

1. Open the Excel file, "MASTER habitat workbook". Save this file as "YourFirstNameYearHABITAT.xls" (e.g. Richard2001HABITAT.xls).
2. Select the worksheet "Route 1" and rename it with a route number (e.g. 3-005).
3. Fill in the route details in the orange box at the top
4. Enter the habitat data. For quicker data entry, copy "100" and paste into cell with CtrlV rather than typing "100" each time.
5. Check your data once it is entered. The far bottom corner (yellow boxes) should read "4000" and "100%" if you have entered everything correctly. If not, check the last column on the right hand side (K) and look for rows that do not add up to 100. There lies your problem.
6. Once you have entered the data, mark the date the data was entered and who it was entered by on the field form.
7. Save, save and save again while you are entering your data!
8. Save a copy on a disk *(will they have zip drives?)*
9. Email to Liz (LizS@telsuplanet.net)
10. Add your habitat data for additional routes to this same workbook (i.e. RichardQuinlanHABITAT not MASTER habitat workbook)

Curlew data entry
Again each workbook can hold up to 20 routes worth of data.
One worksheet per route. Each worksheet can hold up to 200 curlew observations. IF you have more than this for a route (highly unlikely), start a new worksheet (be sure to fill in the route data again) and call it the route number with TWO on the end (e.g. 1-005TWO)

1. Open the worksheet "MASTER Curlew Workbook". Save this file as "YourFirstNameYearCURLEW.xls" (e.g. Richard20001CURLEW.xls).
2. Select the worksheet "Route 1" and rename it with the route number (e.g. 3-005).
3. Fill in the route details in the orange box at the top and the weather details in the blue box.

4. Fill in your curlew observations (one observation per row)
5. As a check, at the end of data entry for a route check that you have the same number of curlew observations on your field form as you do on your worksheet.
6. Once you have entered the data, mark the date the data was entered and who it was entered by on the field form.
7. Save, save and save again while you are entering your data!
8. Save a copy on a disk *(will they have zip drives?)*
9. Email to Liz (LizS@telsuplanet.net)
10. Add your curlew data for additional routes to this same workbook

Priority Incidental Species Data Entry

This is where you enter the data collected on the 6 priority species during the curlew survey

1. Open the worksheet "MASTER Priority Incidental Species.xls". Save this file as "YourFirstNameYearPRIORITY.xls" (e.g. Richard2001PRIORITY.xls).
2. Select the worksheet "Route 1" and rename it with the route number (e.g. 3-005).
3. Fill in the route details in the orange box at the top and the weather details in the blue box.
4. Fill in your incidental observations (one bird per row, even though you may have grouped observations on your form). Under "species" there is a drop down list. You can either select from the list or type in the species abbreviation.
5. As a check, at the end of data entry for a route check that you have the same number of incidental observations on your field form as you do on your worksheet.
6. Save, save and save again while you are entering your data!
7. Save a copy on a disk *(will they have zip drives?)*
8. Email to Liz (LizS@telsuplanet.net)
9. Add your priority incidental species data for additional routes to this same workbook

Other Incidental Species

This is where you enter:

- Observations made during the curlew survey route of any of the incidental species that are NOT one of the 6 priority species.
- Observations of any of the incidental species INCLUDING the 6 priority species made off of the formal surveys (e.g. while traveling to and from routes, while collecting habitat data etc.).

1. Open the worksheet "MASTER Incidental Species.xls". Save this file as "YourFirstNameYearINCIDENTAL.xls" (e.g. Richard2001INCIDENTAL.xls).
2. Enter your incidental observations (one per row – in this case you can enter observations of multiple birds made at the same location and time in the same row). Only fill in the white columns, not the gray ones.
3. Note in the "Breeding Activity" column there is a drop-down list. You may only enter one of the responses on the list. If there was no evidence of breeding observed, simply enter "unspecified activity".

4. Save, save and save again while you are entering your data!
5. Save a copy on a disk *(will they have zip drives?)*
6. Email to Liz (LizS@telsuplanet.net)
7. Add all your incidental observations to this same worksheet.